

Interoperability of WHOS with R WaterML library



R is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing.

The R WaterML library is a software package made by Jiri Kadlec that can be used by developers to access to WHOS functionalities from their R applications.

You can find here the official [homepage of R WaterML library](#).

With Google Colab and Jupyter notebook web applications is possible to live demonstrate on the web how such a library can be used from a sample R script. Here are the online links:

- Google Colab notebook sample connecting to WHOS-Arctic (hosted by Google): <https://colab.research.google.com/drive/1SEEBM5LnUbZdhTItNwc2baauL2-hDNXF>
- Google Colab notebook sample connecting to WHOS-Plata (hosted by Google): <https://colab.research.google.com/drive/1mm3OrERZezUOH5O8Gp-Gs133MwbsCVvy>
- [A Jupyter notebook prepared and hosted by ARPAE Emilia-Romagna](#).
- A Jupyter notebook is made available through Docker from ESSI-Lab. This environment can be reproduced following the below steps.



WaterML_1.7.1.tar.gz



WHOS-Plata-INA.ipynb



WHOS-Arctic-SYKE.ipynb

1) Download the above WaterML R library and the Python notebooks you are interested to try in a local folder.

2) Install Docker

3) From that folder, issue the following command to start the Jupyter Notebook as a localhost service.

```
docker run --rm -p 8888:8888 -e JUPYTER_ENABLE_LAB=yes -v "$PWD":/home/jovyan/work/ jupyter/r-notebook
```

4) Read carefully the logs to find out the URL to use in the browser to access the web GUI. This will be something like:

http://127.0.0.1:8888/?token=my_generated_token

5) Enter the work directory from the left side panel.

6) Open one of the notebook available clicking on the file icon on the left (e.g. WHOS-Plata-INA): the script, along with results and comments should be shown in the main panel.

7) Click on Run Run All Cells to execute the R code on the fly. The first cells will install the provided R WaterML package.

Then, using methods made available by the library, it is shown how it is possible to search and access data from one of the available views of WHOS.

The screenshot shows a JupyterLab environment with a file browser on the left and a code editor on the right. The file browser shows a directory with files: `docker-jupyter.sh` (20 minutes ago), `Plata-INA.ipynb` (17 minutes ago), and `WaterML_1.7.1.tar.gz` (21 minutes ago). The code editor shows the following R code cells:

```
[1]: install.packages('XML')
install.packages('RJSONIO')
install.packages('WaterML_1.7.1.tar.gz', repos = NULL, type="source") #install.packages("WaterML")

Updating HTML index of packages in '.Library'
Making 'packages.html' ... done
Updating HTML index of packages in '.Library'
Making 'packages.html' ... done

[2]: library('WaterML')

[3]: options(repr.matrix.max.cols = 100)

[4]: server <- 'http://gs-service-production.geodab.eu/gis-service/services/essi/view/plata/cuahsi'

[5]: w <- -60.536
s <- -37.426
e <- -56.786
n <- -33.868

[6]: sites <- GetSites(server,w,s,e,n)

[1] "downloading sites from: http://gs-service-production.geodab.eu/gis-service/services/essi/view/plata/cuahsi/1.1.asmx ..."
[1] "download time: 3.5339999999999999 seconds, status: Success"
[1] "reading sites WaterML data..."

No encoding supplied: defaulting to UTF-8.

[7]: sites
```

The output of the `GetSites` function is displayed as a data frame with 100 rows and 10 columns. The first row is shown below:

SiteID	SiteName	SiteCode	FullSiteCode	Latitude	Longitude	Elevation	State	County	Comments
<chr>	<chr>	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<lg>	<lg>	<lg>
1	Manuel Artigas Mal Abrón	0205R8b-c68a- 32e6-9be0-	-0205R8b- c68a-32e6- 9be0-	-34.14900	-56.95200	NA	NA	NA	NA

In particular data from a station managed by INA is finally plotted. Of course this is just a quick sample. An hydrologist could of course expand example given doing further data gathering from the different providers participating in WHOS and then do comprehensive analyse.

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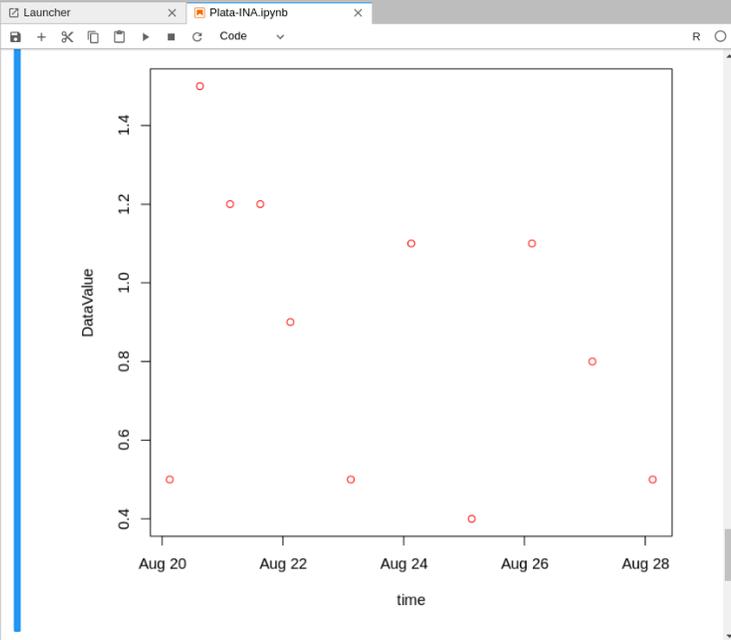
127.0.0.1:8888/lab

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Name	Last Modified
docker-jupyter.sh	20 minutes ago
Plata-INA.ipynb	18 minutes ago
WaterML_1.7.1.tar.gz	21 minutes ago



The scatter plot displays 'DataValue' on the y-axis (ranging from 0.4 to 1.4) against 'time' on the x-axis (ranging from Aug 20 to Aug 28). There are 10 data points represented by red circles. The values fluctuate significantly, with a peak near 1.4 and a low near 0.4.

time	DataValue
Aug 20	0.5
Aug 21	1.4
Aug 22	1.2
Aug 23	0.9
Aug 24	1.1
Aug 25	0.5
Aug 26	1.1
Aug 27	0.8
Aug 28	0.5

0 1 R | Idle Mode: Command Ln 1, Col 1 Plata-INA.ipynb